R E P O R T R E S U M E S

ED 010 756 RE 000 006

THE READABILITY OF SCIENCE TEXTBOOKS FOR ELEMENTARY SCHOOL.

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EDRS PRICE MF-$0.09 HC-$0.24 6P. PUB DATE OCT 65

DESCRIPTORS- *READING DIFFICULTY, *ELEMENTARY SCIENCE, *TEXTBOOK EVALUATION, *READABILITY, INSTRUCTIONAL MATERIALS, SPACHE FORMULA, YOAKAM FORMULA

AN INVESTIGATION WAS MADE OF THE READABILITY LEVELS OF NINE CONTINUOUS SERIES OF ELEMENTARY SCHOOL SCIENCE TEXTBOOKS, GRADES 1-6. THE FOLLOWING SCIENCE SERIES WERE EVALUATED--ALLYN AND BACON, AMERICAN BOOK COMPANY, GINN, HARPER AND ROW, HEATH, LYONS AND CARNAHAN, MACMILLAN, SINGER, AND WINSTON. THE SPACHE FORMULA (SAFIER METHOD) WAS APPLIED TO TEXTBOOKS FOR GRADES 1, 2, AND 3. THE YOAKAM FORMULA WAS USED FOR GRADES 4, 5, AND 6. RESULTS OF THE READABILITY STUDIES ARE PRESENTED IN TABULAR FORM AND DISCUSSED. READING LEVELS FOR FOURTH-, FIFTH-, AND SIXTH-GRADE TEXTS ARE REPORTED TO BE TOO HIGH BECAUSE THE WORD LIST ON WHICH THE YOAKAM FORMULA IS BASED IS SOMEWHAT OUTDATED. REFERENCES ARE GIVEN. THIS ARTICLE IS PUBLISHED IN "ELEMENTARY SCHOOL JOURNAL," 66, OCTOBER 1965. (LS)

Elementary School Journal, 66 (Oct. 1965), 40-43.

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The Readability of Science Textbooks For Elementary School

The science textbook is crucial in teaching science in today's elementary schools. Research shows that most elementary-school science programs are based on the textbook (1). The readability level of science textbooks should, therefore, be of considerable importance in selecting a series for classroom use.

Because of lack of time and training, however, teachers on textbook selection committees may give little attention to the difficulty of the textbooks under consideration. Selection committees interested in readability will be wise not to rely on inspection in making a choice, for this method does not yield results that have any degree of accuracy (2).

The purpose of the study reported here was to determine, through readability formulas, the readability level of nine continuous series of elementary-school science textbooks.

Three studies have been conducted to determine the difficulty of elementary-school science textbooks. These studies were concerned with textbooks for Grades 1, 4, 5, and 6.

Some years ago Mallinson and coworkers analyzed the intermediate-grade textbooks of five unidentified series. The researchers found that most of the textbooks for fourth grade were far too difficult, the textbooks for fifth grade were quite difficult, and the textbooks for sixth grade were somewhat difficult (3).

Burkey analyzed seven textbooks each for Grades 4, 5, and 6. Like Mallinson, Burkey found that the level of difficulty of the textbooks, with respect to the intended readers, decreased slightly from Grade 4 upward (4).

In a recent study (5) researchers determined the difficulty of eight textbooks for first grade. The readability level of four of the textbooks was 1.6, the level of three of the books was 1.8, and one book had a level of 1.9.

In the study reported here the Spache (6) formula was used to determine the readability level of the textbooks intended for Grades 1, 2, and 3; and the Yoakam (7) formula was used to determine the readability level of the textbooks intended for Grades 4, 5, and 6.

In applying the Spache formula, the

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Safier method was used. It permits the use of a table and eliminates all computation in arriving at the readability level (6: 138).

The samples from the textbooks for Grades 1, 2, and 3 consisted of units of a hundred words each. In textbooks for first grade, four units were studied; for second grade, five units; and for third grade, six units. Research has shown that three samples of a hundred words each provide an estimate precise enough for most uses (6: 131).

word units included in the samples in this study was sufficient.

In arriving at the readability level of the textbooks for the intermediate grades, an interpolation of the Cleland table was used with the Yoakam formula. The Cleland table makes it possible to quickly convert data into readability levels (7: 336).

From each textbook evaluated with the Yoakam formula a sample of ten units was taken. Each unit was made up of two hundred words. Yoakam

TABLE 1. *Readability Level of Selected Elementary-School Science Textbook Series*

Publisher	Grade 1	2	3	4	5	6
Allyn and Bacon	1.9	2.0	2.6	3.7	4.8	6.1
American Book Company	2.1	2.4	3.1	5.9	7.1	8.1
Ginn	1.9	2.0	2.7	4.1	4.8	5.6
Harper and Row	1.7	2.2	2.8	6.1	8.1	11.0
Heath, D.C.	1.6	2.0	3.1	5.0	5.4	6.3
Lyons and Carnahan	1.9	2.1	2.5	4.7	6.0	7.1
Macmillan	1.9	2.1	2.9	4.4	5.1	6.5
Singer	1.8	2.2	2.9	5.5	6.6	8.8
Winston	1.8	2.3	2.5	5.1	6.8	7.3

For the present investigation a check was made to determine the effect of the number of units on the results. For this check, units from a third-grade book were used. Each unit consisted of a hundred words. First, the readability level of four units was obtained. Then, two more units were added, and the readability of the six units was obtained. Finally, three more units were added, and the readability of the nine units was obtained. The four units showed a readability level of 2.45; the six units showed a level of 2.53; and the nine units showed a level of 2.55. It seems that the number of a hundred-states that a sample of ten units of a hundred words each gives a reasonably accurate placement of a book for practical purposes (7: 337).

Table 1 shows the readability level of the fifty-four textbooks. The series that showed the most desirable levels were those published by Allyn and Bacon, Ginn, Heath, and Macmillan. The intermediate-grade textbooks of the other series appear to be quite difficult, but caution should be used in interpreting the levels because of possible inadequacies in the readability formulas used in the study.

It is probable that the high reada-

bility level of the intermediate-grade textbooks is due in part to the fact that the Yoakam formula is based on Thorndike's 1932 word list, which is somewhat dated (8). The Yoakam formula is based on words scaled 4 through 20 by Thorndike. A word like *telephone* contributed little or nothing to the readability level of a textbook, because Thorndike rated the word 3. Words that are now almost as common as *telephone* were rated 20 because they were not in Thorndike's list. Among the words that were given a rating of 20 were words like *television* and *astronaut*, which were not common or in existence at the time Thorndike's wordbook was published. Words such as these surely had a considerable influence on the readability level of some of the intermediate-grade textbooks.

In some series the difference between the readability level of the third-grade textbook and the fourth-grade textbook is quite large. Part of the spread is surely due to the use of two readability formulas. When the two formulas were applied to the same third-grade textbook, the Spache formula scaled the book at 2.8, while the Yoakam formula scaled the book at 4.9. The Spache formula scaled one third-grade textbook at 2.6, while the Yoakam formula scaled it at 4.0.

If we assume that the Spache formula scaled the third-grade textbooks correctly, the evidence indicates that the Yoakam formula scaled the intermediate-grade textbooks as much as two years too high. If the readability level of the intermediate-grade textbooks is as high as the Yoakam formula indicates, the Harper and Row fifth- and sixth-grade textbooks were the only intermediate-grade textbooks that may be much too difficult for the average reader for whom they are intended.

TABLE 2. *Changes in Readability of Revised Editions of Four Elementary-School Science Textbook Series*

Publisher	Edition	Grade 4	Grade 5	Grade 6
Allyn and Bacon	1952	4.6	5.6	5.4
	1960	3.7	4.8	6.1
	Change	− .9	− .8	+ .7
Ginn	1950	5.6	5.3	6.4
	1961	4.1	4.8	5.6
	Change	−1.5	− .5	− .8
Singer	1949	5.0	6.2	7.4
	1962	5.5	6.6	8.8
	Change	+ .5	+ .4	+1.4
Winston	1951	5.2	6.5	6.5
	1957	5.1	6.8	7.3
	Change	− .1	+ .3	+ .8

Four of the series of intermediate-grade textbooks considered in this study were revisions of the series that Burkey analyzed with the Yoakam formula ten years before this study (4). Table 2 indicates the approximate changes in the four series from one edition to the next.

If we allow a change of .5 for fluc-

tuations because of the differences in the sampling procedures used in this study and Burkey's, the Allyn and Bacon series decreased slightly in difficulty in Grades 4 and 5, and increased in difficulty in Grade 6. The Ginn textbook for fourth grade decreased considerably in difficulty, while the textbook for sixth grade decreased slightly in difficulty. There was a large increase in the difficulty of the Singer textbook for sixth grade, while the difficulty of the textbooks for fourth and fifth grades remained about the same in the revised edition. The Winston textbooks for sixth grade increased slightly in difficulty, though there was little or no change in the textbooks for fourth and fifth grades.

With the exception of most of the Grade 1 textbooks the readability levels of the textbooks for primary grades, as scaled by the Spache formula, were within a desirable range. The textbooks for Grade 1 appear to be too difficult. However, the majority of the words on which the readability levels of the textbooks for Grade 1 were based appear near the back of the textbooks. By the time the pupil reaches the words, he is in the later months of the school year. When these facts are considered, the levels do not seem unreasonably high.

According to the Spache readability formula, the readability levels of the primary-grade textbooks investigated in this study were well suited for the average reader for whom the textbooks were intended. The readability levels of the intermediate-grade textbooks, as measured with the Yoakam formula, varied widely from series to series. It should be noted that the Yoakam formula may have some inadequacies for measuring the readability of science textbooks. If this fact is taken into account, it may be concluded that most of the intermediate-grade textbooks investigated were near the desired levels for which they were intended.

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